Autnonomous Vehicles: Societal and Technological Evolution (Invited Contribution)

Christian Laugier

Véhicule autonome et ville de demain

Technologie, business et société : quels enjeux ?

Nextdoor Issy Village
41-43 rue Camille Desmoulins
92130 Issy-les-Moulineaux
Mercredi 14 décembre 18h30 - 21h00

Comment le véhicule va-t-il s'adapter à la ville de demain ?
Et comment les villes vont-elles s'adapter au véhicule de demain ?

Pour appréhender le sujet dans son ensemble et entrevoir les risques et opportunités induits par cette « nouvelle » révolution, nous vous invitons à une table ronde animée par **Jean-Michel Normand,** journaliste au Monde, avec :

Vincent Abadie,
Responsable Innovation et Technologies avancées, Aide à la Conduite, Maître-expert, **Groupe PSA**

François Nédey,
Directeur technique Assurance Biens et Responsabilités, **Allianz**

Didier Marginedes,
Senior Vice President, Blue Solutions, **Bolloré**

Eric Legale,
Directeur de **Issy Media**, Société d'Economie Mixte chargée de la communication et des Technologies de l'Information de la ville d'**Issy-les-Moulineaux**.

Emmanuel François,
Président,
Smart Building Alliance for Smart Cities

Christian Laugier,
First Class Research Director, **INRIA CHROMA** - Cooperative & Human-aware Robot Navigation in Dynamic Environments

Olivier Babeau,
Economiste, Professeur des sciences de gestion, **Université de Bordeaux** et spécialiste des transitions numériques

Cars & Human Mobility

A Psychological & Technological evolution

On-going change of the role & concept of **private car** in human society

Ownership & Feeling of Freedom
Affective behaviors & Social position
Driving pleasure ... but less and less true !

*Next cars generation => Focus on **Technologies** for*
Safety & Comfort & Reduced Pollution
Driving Assistance v/s Autonomous Driving

- Context
  - ⇒ *Expected 3 Billions vehicles & 75% population in cities in 2050 (current model not scalable)*
  - ⇒ *Accidents: ~1.2 Million fatalities/Year in the world*
  - ⇒ *Driving safety & Nuisance issues (pollution, noise, traffic jam, parking ...) are becoming **a major issue for both Governments & Industry***

- Technology & Internet progressively change de **mobility habits** of people
  => Shared mobility systems, more carpooling, more ADAS ...
  e.g. Uber, BlaBlaCar, Tesla Autopilot ...

- A Huge ADAS market for Automotive Industry
  ***=> $16 billions** in 2012 & Expected **$261 billions** in 2020 [f]*

[f] Forecasted US$ 260 Billion Global Market for ADAS Systems by 2020. ABI Research. 2013.

Autonomous Vehicles: 30 years R&D

Pioneer work at INRIA in the 90's : *Autonomous parking, Platooning in cities, People mover (Cycab)*

1986 VaMors (Dickmann Munich U)
First autonomous véhicle on a road,
Followed by EU project Prometheus

2004 Darpa Grand Challenge
Significant step towards Motion Autonomy
... But still some uncontrolled behaviors

2007 Darpa Urban Challenge
97 km, 50 manned & unmanned vehicles, 35 teams

2011 Google Car project
Fleet of 6 automated Toyota Prius
140 000 miles covered on California roads
with occasional human interventions

Numerous real-life experiments ...but Safety is still insufficient

=> Some benign & serious accidents in the past few months (Google, Tesla ..)

Autonomous Car: Next generation technology & Expected market of 500 B€ in 2035

Tesla Autopilot based on Radar & Mobileye

- *Partnership with Mobileye uncertain*
- *Commercial option : 3400 € in France*

Costly 3D Lidar & Dense 3D mapping

Cybus experiment, La Rochelle 2012
(CityMobil Project & Inria)

Drive Me trials

- *100 Test Vehicles in Göteborg, 80 km, 70km/h*
- *No pedestrians & Plenty of separations between lanes*

Driverless Taxi testing in Pittsburgh *(Uber)* & Singapore *(nuTonomy)*

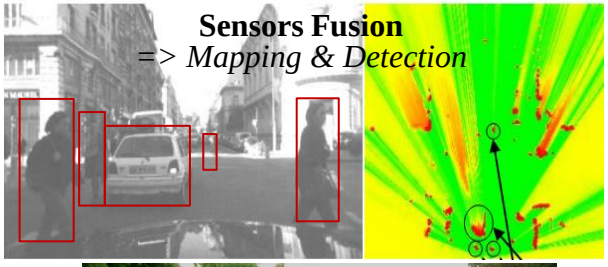
=> Numerous Sensors & Engineer in the car during testing

Key Technologies: Embedded Perception & Decision

=> Decision-making for navigation while avoiding pending & future collisions

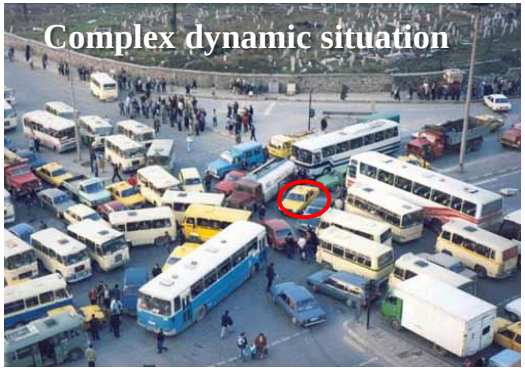
Embedded Multi-Sensors Perception
=> Continuous monitoring the dynamic environment

Sensors Fusion
=> Mapping & Detection



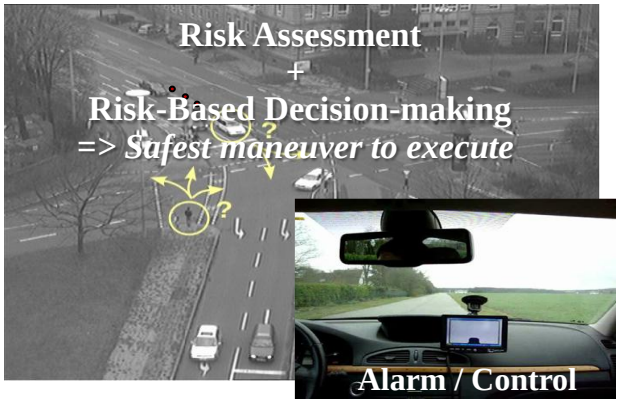
Scene interpretation
=> Using Context & Semantics

Characterization of the Safe navigable space (local)



Human Aware Situation Assessment

Risk Assessment
+
Risk-Based Decision-making
=> Safest maneuver to execute



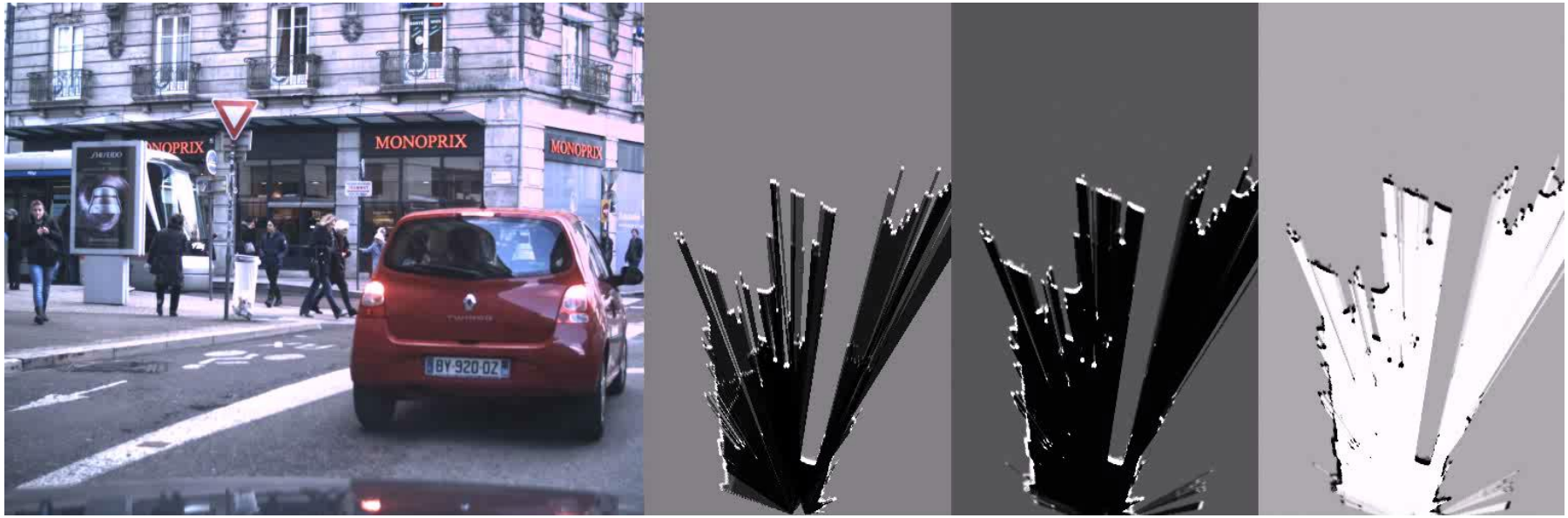
Main features

Noisy data, Incompleteness, Dynamicity, Discrete measurements + ***Real time***

Human in the loop & Environment change prediction required

=> Situation Awareness, Prediction & Risk assessment, Human-Vehicle Interactions

Exploiting dynamics for Scene Understanding



Motion Prediction for collision avoidance (Risk)

=> Detect future collision & Avoid false alarms

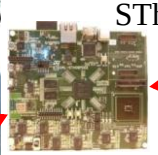
2005

2015

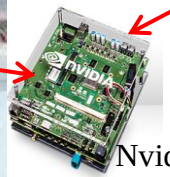
Embedded perception & V2X Communication

CPU+GPU+ROS / Stereo vision + Lidars + GPS + IMU + Odometry

Toyota Lexus



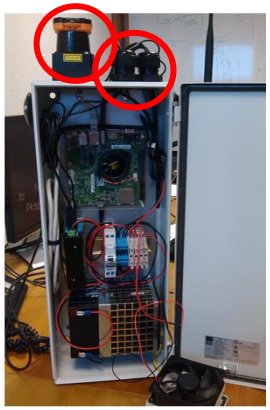
Manycore
SThorm



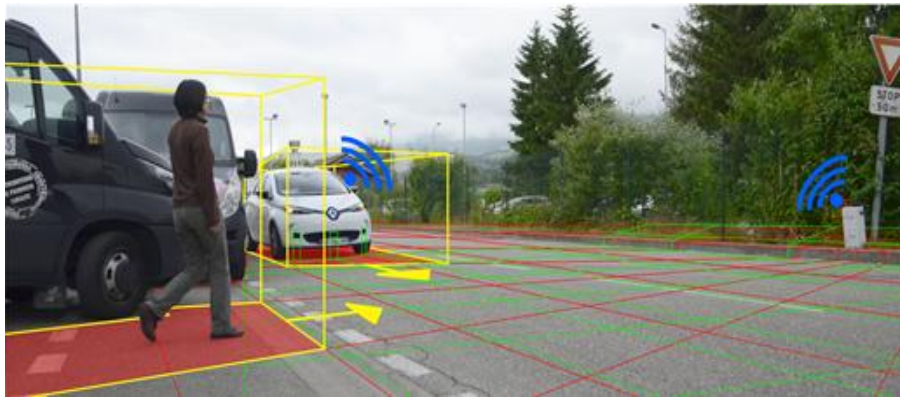
GPU
Nvidia Jetson

Miniaturization

Renault Zoé



Integrated Perception Box
Movable & Connected



Inria
INVENTORS FOR THE DIGITAL WORLD

NANOELEC.